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PHYSICS

SENIOR DIVISION

GRADE 11

Replacing the Physics course as printed in Curriculum S.17, Science and Agricultural Science.

For introduction in September, 1963

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PHYSICS

Grade 11

The time allotment suggested for the course in Physics is an indication of the comparative depth of treatment to be given each unit. Teachers are encouraged to amplify and extend the study of individual items as time permits. The teacher is free to determine the order in which the various units will be studied, although he will probably prefer to begin the year's work with Unit One, and to conclude it with Unit Five.

The ultimate aim of the course is adequate understanding of the concepts and the principles involved. This aim is best served if the experimental approach is emphasized.

Pupil records should include well-labelled diagrams; observations and conclusions must be expressed in clear, concise English.

Pupils should be taught to support generalizations by applications which are to be found in abundance in the world about them.

Time Allotment

Mechanics	30 periods
Vibrations and Wave Motions	32 periods
Heat	8 periods
Electricity	50 periods
Topics in Modern Physics	40 periods

Unit 1 MECHANICS (30 periods)

1. Measurements
   (a) Review of measurements as prescribed for Grade 9.
   (b) The three fundamental measurements: length, mass, and time.

(c) Systems of measurement: British System (F.P.S.) and Metric System (M.K.S. and C.G.S.)

(d) The accuracy of measurements. (No measured quantity is completely accurate.) Approximate measurements.

2. Motion and Force

(a) Explanation of motion, speed, velocity and acceleration. Simple problems. Vector and scalar quantities. All motion is relative. Problems on relative velocities of moving objects.

The formula $v = u + at$. Simple problems.

(b) Review examples of force (Grade 10) and extend the idea of force to include direction (vector quantity). Review Newton's First Law of Motion. Inertia as a property of matter. Simple experiments to show inertia in both stationary and moving objects. Mass as a measure of inertia. Examples of inertia.

(c) Newton's Second Law of Motion. The relation of acceleration to force and mass.

The formula $F = ma$. The newton as an absolute unit of force. The advantage of using absolute rather than gravitational units of force. Examples of balanced and unbalanced forces acting on objects at rest and in motion.

Simple problems.

(d) Newton's Third Law of Motion. Examples.

(e) Gravitational force as a property of all matter, the meaning of weight.

The factors affecting gravitational force — Newton's Law of Universal Gravitation.

The variation of weight with distance from the centre of the earth.

The differences between mass and weight.

3. Work, Energy, and Power

(a) Review the meaning of work in mechanics. Definition of joule (newton-metre).

(b) The meaning of energy. Kinetic and potential energy. Heat as kinetic energy of molecules.

(c) The conservation of energy.

Study of a simple pendulum. The sum of the kinetic and potential energy remains a constant (neglecting friction).

(d) Bernoulli's Principle as an application of the conservation of energy.

(e) Applications of Bernoulli's Principle.

(f) The watt and the kilowatt.

Relation of the watt and the kilowatt to horsepower.

Applications and simple problems.

4. Archimedes' Principle and the Law of Flotation

(a) Review the meaning of density and specific gravity.

Various units for measuring density. The relation of density to specific gravity.

(b) Class experiment to illustrate Archimedes' Principle.

(c) Use of Archimedes' Principle to find the specific gravity of a solid and a liquid.

(d) Class experiment to illustrate the Law of Flotation.

Buoyancy as it applies to submarines, ships, balloons, etc.

(e) The principle of the hydrometer.

Problems should be introduced where applicable in this section.

Unit 2
VIBRATIONS AND WAVE MOTIONS (32 periods)

1. Transmission

(a) Review vibrations and related terms.

(b) Demonstrate the transmission of energy by transverse and longitudinal waves. The transmission of energy from particle to particle in the form of vibrations.

(c) The universal wave equation (velocity is equal to the product of frequency and wave-length). Simple problems.

(d) The concept of interference in transverse and longitudinal waves.

Illustrate by one or more mechanical demonstrations.

2. Sound

(a) A brief review of the concepts discussed in Grade 9.

(b) (i) A quantitative experiment to show that the frequency of a stretched string varies inversely as the length.

(ii) Demonstration of the dependence of frequency on the tension, diameter, and density of the string.

(c) One or more experiments to illustrate interference, e.g.,

(i) silent regions near a sounding tuning fork,

(ii) production of beats,

(iii) silent regions near two loudspeakers connected to the same source.

(d) Resonance

(i) Mechanical illustration of the principle of resonance.

(ii) Experiment to demonstrate sympathetic vibrations by resonance.

(iii) Experiment to demonstrate resonance in air columns of different lengths. Application in musical instruments.

3. Light

(a) (i) A brief review of light transmission (Grade 10).

(ii) Review and extend the work on reflection to include experiments using a concave mirror. Locating images by diagram.

(iii) Review refraction. Extend to include index of refraction. Critical angle and total reflection.

(b) Lenses

(i) Experiments to show the effect of (1) a convex lens (2) a concave lens on a beam of parallel rays.

(ii) Experimental study of real and virtual images formed by a convex lens.

(iii) Locating images by diagram for convex and concave lenses.

(c) Applications — a general understanding of two or three of the following:

(i) the camera and the projector,

(ii) the normal eye and eye faults: correcting lenses,

(iii) simple and compound microscopes,

(iv) refractor telescopes, celestial and terrestrial,

(v) the prism binocular and the functions of the prisms.

(d) A demonstration of Young's double slit experiment to show the interference and wave nature of light.

Unit 3 HEAT (8 periods)

1. Review the following, using the kinetic theory as the unifying concept:

(a) Transfer of heat,

(b) Expansion,

(c) Thermometry,

(d) Quantity of heat,

(e) Changes of state.

2. Calorimetry
   (a) Design of a calorimeter to minimize heat transfer.
   (b) Review specific heat.
   (c) Experiment to determine the heat of vaporization of water. Consideration of possible sources of error.
   (d) Problems.

Unit 4 ELECTRICITY (50 periods)

1. Electrostatics
   (a) Review of the concepts taught in Grade 10.
   (b) The electrical structure of solids and explanation of electrostatic effects.
   (c) Charging a conductor by induction. Explanation.

2. Current Electricity
   (a) The transformation of mechanical, chemical and radiant energy into electrical energy.
   (b) Review of electrical symbols and circuits.
   (c) Definitions of the following units:
      (i) one coulomb as 6.24×10^{18} electrons,
      (ii) one ampere as 1 coulomb per second,
      (iii) one volt as one joule per coulomb.
   (d) The transformation of electrical energy to heat energy. Experiment to determine the electrical energy equivalent of 1 calorie. Simple problems.
   (e) Experiment to determine the relation between the p.d. across the ends of a conductor and the current through it — Ohm's Law.
      Definition of 1 ohm resistance as 1 volt per ampere.
   (f) Factors affecting the resistance of a conductor.
   (g) Problems involving Ohm's Law, including examples with resistors in series and in parallel.

(h) The power rating of electrical appliances. The kilowatt-hour as a unit of energy. Problems, including the cost of electrical energy.

3. Electromagnetism

(a) Brief review of magnetism.

(b) Demonstration of induced magnetism; discussion of permeability.

(c) Review of the magnetic field about conductors where electrons are moving

(i) in a straight wire,

(ii) in a single loop,

(iii) in a helix or coil. The left hand rules.

(d) Experiments to determine the relation between the strength of the magnetic field and

(i) the magnitude of the current,

(ii) the number of turns in the coil.

(e) Experiment to show the effect of the permeability of the core material on the strength of the magnetic field.

(f) Practical applications of electromagnets.

(g) Experiment to illustrate the motor principle.

(h) The moving-coil galvanometer.

(i) The use of the moving-coil assembly in ammeters and voltmeters. The structure, uses, and resistance qualities of good meters.

(j) Electromagnetic induction: experiments to illustrate the production of a potential difference by moving a magnet near a conductor.

(k) Factors determining the magnitude of the induced potential difference.

(l) Experiment to illustrate the production of an induced current by opening and closing a primary circuit coupled with a secondary circuit.

(m) Lenz's Law: the direction of the induced current (electron flow); the application of energy conservation to electro-magnetic induction.

(n) The alternating current generator. The use of slip rings.

(o) The two-segment commutator to convert an A.C. generator to a D.C. generator.

(p) The simple D.C. motor.

(q) Transformers. The structure and action of step-up and step-down transformers.

(r) Uses of transformers. The distribution of electrical energy.

Unit 5

TOPICS IN MODERN PHYSICS (40 periods)

1. Electronics
   (a) Conduction through gases
   (b) Cathode rays
   (c) X-rays
   (d) Photoelectricity
   (e) Thermionic emission
   (f) Rectification
   (g) Amplification
   (h) Application of rectifiers and amplifiers in radio and communication
   (i) Application of the above principles in television.

2. Atomic Structure
   (a) Charge/mass ratio for electrons (Thomson)
   (b) Charge on electrons (Millikan)
   (c) Radioactivity
   (d) Concept of the nucleus (Rutherford's experiment)

(e) The Bohr concept of the hydrogen atom

(f) Structure of the nucleus; atomic number; mass number; isotopes

(g) Electron shell structure.

3. Nuclear Physics

(a) Simple nuclear reactions

(b) Nuclear fission

(c) Nuclear fusion.

4. Living in an Atomic Age

(a) The impact of nuclear physics on everyday life

(b) Radiation hazards.